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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/517,575	12/09/2004	Victor Lu	H0004019 (4780)	1366

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Princeton, NJ 08542-0484

EXAMINER

HARRISON, MONICA D

ART UNIT	PAPER NUMBER
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2813

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06/27/2007

PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No. 10/517,575	Applicant(s) LU ET AL.	
	Examiner Monica D. Harrison	Art Unit 2813	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 23 January 2007.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-23 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-23 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
 Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
 Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08)
Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

1. Applicant's arguments filed 1/23/07 have been entered.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1-15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Gallagher et al (6,596,467 B2) in view of Gnade et al (5,804,508).

2. Regarding claim 1, Gallagher et al discloses a multilayered dielectric structure which comprises: a porous dielectric layer which has a porosity of about 10% or more (Figure 7, reference 15 and an adhesion promoting dielectric layer on the porous dielectric layer which has a porosity of about 10% or less (column 11, lines 49-51, (*B-Stage dielectric matrix*)). However, Gallagher et al does not disclose a substantially nonporous capping layer.

Gnade et al discloses a substantially nonporous capping layer (Figure 3C, reference 30).

It would have been obvious, at the time the invention was made, for one having ordinary skill in the art, to modify Gallagher et al, with the teachings of Gnade et al, for the purpose of making a low dielectric constant material for electronics.

3. Regarding claim 2, Gallagher et al discloses wherein the porous dielectric layer is further disposed on a substrate (Figure 4, reference 10).

4. Regarding claim 3, Gallagher et al discloses wherein the porous dielectric layer has a porosity of from about 10% to about 90% (Figure 7, reference 15).

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5. Regarding claim 4, Gallagher et al discloses wherein the porous dielectric layer has a dielectric constant of from about 1.3 to about 3.0 (column 1, lines 24-30; *silicon dioxide is a known low-k material*).

6. Regarding claim 5, Gallagher et al discloses wherein the combination of the porous dielectric layer and the adhesion promoting dielectric layer has an effective dielectric constant of from about 1.4 to about 3.0 (Figure 7).

7. Regarding claim 6, Gallagher et al discloses wherein the porous dielectric layer comprises a material selected from the group consisting of a nanoporous silica, silicon oxide, organosilsesquioxane, a polysiloxane, a poly (arylene ether), a polyimide and combinations thereof (column 1, line 29; *poly (arylene ether)*).

8. Regarding claim 7, Gallagher et al discloses wherein the adhesion promoting dielectric layer has a porosity of from about 0.1% to about 13% (column 11, lines 49-51, (*B-Stage dielectric matrix*)).

9. Regarding claim 8, Gallagher et al discloses wherein the adhesion promoting dielectric layer has a dielectric constant of about 2.8 or more (column 11, lines 49-51, (*B-Stage dielectric matrix*)).

10. Regarding claim 9, Gallagher et al discloses wherein the adhesion promoting dielectric layer has a dielectric constant of from about 2.8 to about 4.0 (column 11, lines 49-51, (*B-Stage dielectric matrix*)).

11. Regarding claim 10, Gallagher et al discloses wherein the adhesion promoting dielectric layer comprises a material selected from the group consisting of a nanoporous silica

silicon oxide, an organosilsesquioxane, a polysiloxane, a poly (arylene ether), a polyimide and combinations thereof (column 4, lines 48-57; *poly (arylene ether)*, *polyimide*).

12. Regarding claim 11, Gallagher et al discloses wherein the capping layer has a dielectric constant of from about 2.8 to about 7.0 (Figure 7, reference 35).

13. Regarding claim 12, Gallagher et al discloses wherein the capping layer comprises a material selected from the group consisting of silicon carbide, silicon oxide, silicon nitride, silicon oxynitride, tungsten, tungsten nitride, tantalum, tantalum nitride, titanium, titanium nitride, titanium zirconium nitride, and combinations thereof (column 9, lines 25-28).

14. Regarding claim 13, Gallagher et al discloses wherein the ratio of the thickness of the adhesion promoting dielectric layer to the total thickness of the adhesion promoting dielectric layer and the porous dielectric layer ranges from about 0.02 to about 30 (Figure 7).

15. Regarding claim 14, Gallagher et al discloses wherein the adhesion promoting dielectric layer, the porous dielectric layer, and the capping layer are adhered to one another to a degree sufficient to pass the ASTM D 3359-97 test (Figure 7).

16. Regarding claim 15, Gallagher et al discloses a microelectronic device which comprises a substrate (Figure 4, reference 10), a porous dielectric layer on the substrate (Figure 7, reference 15), said porous dielectric layer having a porosity of about 10% or more; an adhesion promoting dielectric layer on the porous dielectric layer which has a porosity of about 10% or less (column 11, lines 49-51, (*B-Stage dielectric matrix*); and a substantially nonporous capping layer on the adhesion promoting dielectric layer (Figure 7, reference 35).

Claims 16-23 are rejected under 35 U.S.C. 103(a) as being unpatentable over Gallagher et al (6,596,467 B2) and Gnade et al (5,804,508) in view of Leung et al (US 2005/0106376 A1).

17. Regarding claim 16, Gallagher et al discloses coating the substrate (Figure 4, reference 10) with a polymer (column 11, lines 49-51, (*B-Stage dielectric matrix*) and a porogen (column 11, lines 49-51, (*B-Stage dielectric matrix*) and Gnade et al discloses a nonporous capping layer (Figure 3C, reference 35). However, Gallagher et al does not disclose the solvent, optional catalyst nor the gelled film and heating of the gel.

Leung et al discloses the solvent (pg.1, paragraph 0008), optional catalyst (pg.1, paragraph 0002) the gelled film (pg.2, paragraph 0015) and heating of the gel (pg.2, paragraph 0016).

It would have been obvious, at the time the invention was made, for one having ordinary skill in the art, to modify Gallagher et al with the teachings of Leung et al, for the purpose of improving nanoporous silica dielectric films in semiconductor devices.

18. Regarding claim 17, Leung et al discloses wherein the second composition is absent of a porogen (pp.4-5, paragraphs 0059-0060).

19. Regarding claim 18, Leung et al discloses wherein the first composition and the second composition comprises a metal-ion-free catalyst selected from the group consisting of onium compounds and nucleophiles (pg.2, paragraph 0013).

20. Regarding claim 19, Leung et al discloses wherein the first composition comprises a porogen which is selected from the group consisting of a polyalkylene oxide, a monoether of a polyalkylene oxide, fully end-capped polyalkylene oxides, Crown ethers, an aliphatic polyester, an acrylic polymer, an acetal polymer, a poly (caprolactone), a poly (valeractone), a poly (methyl methacrylate), a poly (vinylbutyral) and combinations thereof (pg.5, paragraph 0062).

21. Regarding claim 20, Leung et al discloses wherein the first composition and the second composition comprises a silicon containing pre-polymer selected from the group consisting of an acetoxysilane, an ethoxysilane, a methoxysilane, and combinations thereof (pg.4, paragraph 0053).

22. Regarding claim 21, Leung et al discloses wherein the coating of the second composition onto the porous dielectric layer results in an infiltration of the second composition into the porous dielectric layer of about 300 angstroms or less (pg.3, paragraph 0045).

23. Regarding claim 22, Leung et al discloses wherein the first composition and the second composition comprises a silicon containing pre-polymer selected from the group consisting of tetraacetoxysilane, a C₁ to about C₆ alkyl or aryltriacetoxysilane, and combinations thereof (pg.4. paragraph 0052).

24. Regarding claim 23, Leung et al discloses wherein said triacetoxysilane is methyltriacetoxysilane (pg.4, paragraph 0052).

Response to Arguments

25. Applicant's arguments with respect to claims 1-23 have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Monica D. Harrison whose telephone number is 571-272-1959. The examiner can normally be reached on M-F 7:00am-3:30pm.

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If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl Whitehead Jr. can be reached on 571-272-1702. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Monica D. Harrison
AU 2813

mdh
June 24, 2007



MICHAEL LEBENTRITT
SUPERVISORY PATENT EXAMINER